

华东地区一些植物的细胞学研究(1)

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关键词 夏蜡梅; 蜡梅; 华重楼; 浙贝母; 染色体数目; 细胞地理

众所周知, 东亚植物区系中, 有一系列的近缘种类, 自东喜马拉雅地区经我国中部, 一直分布到朝鲜或日本, 成替代现象。如西域旌节花 *Stachyurus himalaicus* Hook. f. et Thoms., 中国旌节花 *Stachyurus chinensis* Franch. 和早春旌节花 *Stachyurus praecox* Sieb. et Zucc. (汤彦承等 1983); 西域青荚叶 *Helwingia himalaica* Hook. f. et Thoms., 中华青荚叶 *Helwingia chinensis* Batalin 和青荚叶 *Helwingia japonica* (Thunb.) Dietrich (Hara & Kurosawa 1975); 西域蜡瓣花 *Corylopsis himalayana* Griffith, 蜡瓣花 *Corylopsis sinensis* Hemsl. 和光轴蜡瓣花 *Corylopsis glabrescens* Franch. et Sav. (Morley & Chao 1977) 等等。有趣的是, 分布于我国的种类, 其变异类型的复杂性远非分布于喜马拉雅和日本者可比拟, 如上述的中国旌节花、中华青荚叶和蜡瓣花, 每个种均可分为几个亚种或变种, 有些作者甚至可将它们细分成若干种, 如吴征镒 (1977) 和张宏达 (1979) 对蜡瓣花的研究。因此除研究分布于东亚地区两端植物的变异和细胞学关系外, 若着重研究分布于我国西南、华中和华东的这些替代种在形态上的变异, 并与染色体上的变化相印证, 定能使我们对东亚植物区系的发生和发展以及物种分化的认识有所深化。应用细胞学的方法来研究植物地理学已日显重要 (Turrill 1959), 并已发展为一新的分支学科——细胞地理学。Davis & Heywood (1963) 还引用 Favargar & Contandriopoulus (1961) 的观点, 认为用细胞学的方法去了解特有和替代分类群是唯一客观的方法。本篇以及已发表的《中国旌节花科的系统研究(一)》、《四川及其邻近地区一些植物的细胞学研究(一)》和今后即将发表的一系列类似的论文, 均从这一目标出发, 是研究东亚植物区系的长期工作的一部分。

本论文所采用的制片方法和《四川及其邻近地区一些植物的细胞学研究(一)》一文中的方法相同, 若个别材料采用秋水仙碱作前处理者, 在文中特别予以注明。凭证标本均藏于中国科学院植物研究所。

1. 夏蜡梅

Calycanthus chinensis Cheng et S. Y. Chang (*Sinocalycanthus chinensis* Cheng et S. Y. Chang)

我们的观察结果: $2n = 22$, 叶尖细胞, 有丝分裂中期(图版 1: 1)。

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理。

我们观察的数目和李林初、徐炳声(1986)的报道相同。夏蜡梅特产我国浙江东部和西北部,于1963年由郑万钧、章绍尧教授所发表,但于次年,他们认为本种不同于北美特产的 *Calycanthus* 属,而另立一新属 *Sinocalycanthus*。Nicely (1965) 发表 *Calycanthaceae* 专著时,只在附注中对本种作了说明,因当时缺乏材料,不足以正确评价,所以没有包括在他的专著内,看来这也合乎情理,因该种的发表仅在 Nicely 发表专著前 1—2 年。后来 Wood (1970) 明确指出,将 *C. chinensis* 另建立一个属 *Sinocalycanthus* 是不合理的。李秉滔(1979)也认为 *Sinocalycanthus* 宜归并于 *Calycanthus*。至此,本属仅 3 种 (*Calycanthus australiensis* Diels 最近被重新发现,另建立一新属 *Idiospermum* Blake 1972, 容后论述)。一种分布于美国东南部 (*C. floridus* L.), 一种分布于美国加州 (*C. occidentalis* Hook. et Arnott), 另一种仅产我国浙江 (*C. chinensis*)。这种间断分布的式样明显表示该属的古老性,这些植物被称为“北极第三纪孑遗植物”(arcto-tertiary relict)。因此,对这些植物进行细胞学研究,在细胞地理学当颇具兴趣。本属的染色体数目,除本文所报道 *C. chinensis* 外,其它两种为 *C. occidentalis* $n = 11$ (Cave 1949 转引自 Nicely 1965), *C. floridus* $n = 11$, $2n = 22$ (Sax 1933, Nicely 1965), *C. fertilis* Walt $n = 11$ ($= C. floridus$ var. *oblongifolius* (Nutt.) B. E. Boufford et S. A. Spongberg, Sax 1933)。Sax 和 Nicely 都报道过 *C. floridus* 的三倍体, Nicely 还观察到 *C. floridus* var. *laevigatus* (Willd.) Torr. et Gray ($= C. floridus$ var. *oblongifolius*) 的根尖细胞具有一个很小的 B 染色体 ($2n = 22 + 1B$)。Raven (1975) 和 Ehrendorfer (1976) 在总结 *Calycanthaceae* 的染色体数目时,均认为它的基数 $x = 11$,虽然 Schürhoff 报道过 *C. floridus* 和 *C. occidentalis* $2n = 24$, 但 Raven 和 Ehrendorfer 都不予以理会,可能如同 Nicely 所说, Schürhoff 所研究的无融合生殖是基于个别栽培植株,需要重新核实。

2. 蜡梅

Chimonanthus praecox (L.) Link

观察结果: $2n = 22$, 叶尖细胞,有丝分裂中期(图版 1: 3)。

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我们的观察结果和前人 (Sugiura 1931, 以及 Simonet 和 Miedzyrzedzi 1932 对 *C. fragrans* Lindl. $= C. praecox$ 转引自 Federov 1969) 所观察结果相同。本种在国外及国内大多数地方均为栽培,野生者不多。据 Rehder and Wilson 在 1913 年记载,在鄂西、川东当时尚较多见,现也残剩不多。

本属特产我国,现记载有 6 种,但有些种之间区别较小,有待进一步研究。本属分布华东至西南地区,除本种有染色体数目报道外,其它各种尚未做过任何细胞学方面的研究,且本种的计数、材料均来自栽培植物。若要全面了解蜡梅属 *Chimonanthus* 和夏蜡梅属 *Calycanthus* 的关系,对本属的其它各种作些细胞学研究实有必要。

在初步了解夏蜡梅属和蜡梅属的分布和染色体数目后,我们在这里不妨对蜡梅科 *Calycanthaceae* 稍加论述,因为进一步对它的研究无论对原始植物各科间的关系以及对南北半球植物的间断分布的了解,都有所裨益。自 Blake (1972) 将局限于澳大利亚昆兰北

部的 *Calycanthus australiensis* Diels 建立一新属 *Idiospermum*, 并独立成科 *Idiospermaceae* 之后, 对蜡梅科的范围就有两种意见。一种意见认为蜡梅科应包括三个属 (*Calycanthus*, *Chimonanthus*, *Idiospermum*), 如 Chant (1978), Takhtajan (1980), Thorne (1983), [Dahlgren (1983)。另一种意见认为 *Idiospermum* 应独立成科, 如沃克 Walker (1976, 从花粉学观点, 虽主张分为两个科, 但仍认为 *Idiospermum* 的花粉非常相似于 *Calycanthaceae* 的花粉), 如 Wilson (1976, 1979 从解剖学观点), Sterner 和 Young (1980, 从植物化学观点), Cronquist (1981)。但细心研究他们的观点之后, 使人会看到主张将 *Idiospermum* 合并于蜡梅科者, 大都将它成为该科中的一个亚科 *Idiospermoideae*; 主张分为两科者, 也都认为它们是十分近缘的科。因此, 这二种观点实际上是十分相近的。从细胞学的观点, *Idiospermum* $2n = 11$ (Blake, 1972), 所以我们同意它仍留于蜡梅科。至于蜡梅科宜隶于何目, 也有两种观点, 我们考察这三个属的地理分布, 南北半球的间断和东西半球温带的间断分布兼而有之, 这表明广义的 *Calycanthaceae* 是一个十分古老的科, 加之形态特征上的原始性, 我们同意 Chant (1979)、Takhtajan (1980)、Cronquist (1981)、Thorne (1983)、Dahlgren (1983) 的观点, 把它置于樟目 (Laurales) 中, 而不同意 Hutchinson 把它置于蔷薇目 (Rosales) 中。

3. 华重楼

***Paris polyphylla* Sm. var. *chinensis* (Franch.) Hara**

观察结果: $2n = 10$, 子房壁细胞有丝分裂中期, 未见 B 染色体。(图版 1: 4)。

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七叶一枝花 (*Paris polyphylla* Sm.) 是一个多型种, 分布自喜马拉雅东部经我国西南、华中、华南至台湾省, 也可说是重楼属 *Paris* 中分化最强烈的一种。不同的作者对它的不同类型, 所给予分类上的等级也不尽相同, 如 Hara (1969) 将它分为三个亚种和九个变种, 即 subsp. *polyphylla*, subsp. *marmorata* (Stearn) Hara, subsp. *fargesii* (Franch.) Hara。后来张芝玉 (1978), Takhtajan (1983), 李恒 (1984) 都把后二个亚种作为种一级来对待, 我们同意他们的观点。即使将后二个亚种从七叶一枝花中分出后, 狭义的七叶一枝花 (即 Hara 的所谓 subsp. *polyphylla*) 也仍然是个极为复杂的类群, Hara 将它分为 9 个变种, 张芝玉除对个别类型作某些调整外, 基本上同意 Hara 的意见。但 Takhtajan 把有些类型, 如 var. *yunnanensis* (Franch) Hand.-Mazz., var. *chinensis*. (Franch.) Hara 都提升为种, 我们不同意 Takhtajan 的意见, 而同意张芝玉、李恒的意见, 鉴于这些类型具有一系列的连续变异, 暂以变种处理为宜。七叶一枝花非但在外部形态上变异甚大, 在核型上同样具有许多细胞型。Hara 总结 1969 年以前的资料, 细胞型达 8 个之多。除有二倍体 ($2n = 10$) 和四倍体 ($2n = 20$) 之外, 在 B 染色体的数目上也有较多的变异。最近, 顾志建 (1982) 观察了三个不同地点 (云南的罗平、彝良、寻甸) 的七叶一枝花的核型, 除数目 $2n = 10$ 相同之外, 非但在随体和 B 染色体的数目上有变异, 并发现在同一地点 (寻甸) 的材料中, 被编号为 B 的二条同源染色体, 在长度上也不相等。

华重楼的核型变异也相当大, 如 Hara 引证 Gotoh & Kikkawa (1937) 观察台湾材料的结果, 和我们观察的也不相同。台湾的除有 2 条 B 染色体外, 在 5 条染色体中被编号

为C的染色体,其短臂有长、短之别。由此可见,七叶一枝花及其变种在外部形态上的变异和核型上的变化有何相关性,还有许多工作要做。

4. 浙贝母

Fritillaria thunbergii Miq. (*F. verticillata* Willd. var. *thunbergii* (Miq.) Baker)

观察结果: $n = 12$, 花粉母细胞减数分裂前期 I 的双线期(图版 1: 2, 5)。

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本种野生于我国江苏、浙江、湖南以及日本,但在浙江等地有大量栽培,为药材“浙贝”的原植物。我们的观察结果和 Sato (1942) 观察日本产的本种的根尖细胞有丝分裂 $2n = 24$, 在数目上相吻合。在减数分裂后期 I 我们还观察到一个桥和一个断片。一般认为在该期一个桥和一个断片的出现,表示一对染色体是臂内倒位杂合性并在倒位环内进行过一次交换(J. Schulz-Schaeffer 1980)。早期在研究重楼属 *Paris*、黄精属 *Polygonatum*、铁线莲属 *Clematis* 等属时,确也用桥和断片来指示倒位的杂合性,但后来如 Haga, J. L. Walters, M. Walters, Lewis & John 等人对玉米 (*Zea*), 雀麦属 (*Bromus*) 等植物的研究,认为桥的产生也可由染色体本身的断裂再融合(reunion)所引起(Grant 1975), Grant 还引用 Newman 对 *Podophyllum peltatum* 的研究来说明。Newman 发现该种减数分裂的后期虽有桥出现,但在粗线期(pachytene)并未见倒位环,因此 Newman 重新检查以前有关这方面的报道,认为植物居群中倒位的频率被估计过高。我们虽在本种减数分裂后期 I 观察到桥和断片,但是否确实存在着倒位,宜作进一步研究。

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CYTOLOGICAL STUDIES ON SOME PLANTS OF EAST CHINA (1)

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Abstract In the East Asiatic temperate floristic region, there are many groups of allied plants generally distributed from the Himalayas to Japan or Korea through China. The following species may be taken as examples: *Stachyurus himalaicus* Hook. f. et Thomas.—*S. chinensis* Franch.—*S. praecox* Sieb. et Zucc., *Helwingia himalaica* Hook. f. et Thomas.—*H. chinensis* Batal.—*H. japonica* (Thunb.) Dietrich, *Corylopsis himalayana* Griffith—*C. sinensis* Hemsl.—*C. glabrescens* Franch. et Sav. It is intriguing to us that the taxa distributed in China are more variable than those in other regions. As considered by Favargues and Contandriopoulos, cytogeography is the only objective method in the understanding of endemics and corresponding (vicariant) taxa. So we believe that the studies on karyological relationship between the Japano-Himalayan elements, especially the variation between Chinese taxa in chromosome, morphology and geography (or ecology) will bring some light on the understanding of speciation of vicariants. This paper along with the others (Tang et al. 1983, 1984) is the results of the project "Studies on the Flora of Eastern Asiatic Region". It is hoped that these studies will eventually deepen our understanding of the origin and differentiation of this flora.

The method used here is the same as that in first paper of the series. Voucher specimens are kept in PE. Four species investigated here are cultivated in the Hangzhou Botanical Garden.

1. *Calycanthus chinensis* Cheng et S. Y. Chang (*Sinocalycanthus chinensis* Cheng et S. Y. Chang)

Somatic chromosome number, $2n=22$, was determined from leaf-tip cells (pl. 1, fig. 1). The material was pretreated with 0.05% Colchicine solution. The voucher specimen: Y. C. Tang & Q. Y. Xiang no. 84-79. *Calycanthus* is a genus of only 3 species, *C. floridus* L. in southeastern United States, *C. occidentalis* Hook. et Arnott in northern coastal ranges and Sierra Nevada foothills, California, *C. chinensis* Cheng et S. Y. Chang in Zhejiang, China. The pattern of disjunct distribution of the genus, with two survivors in eastern and western North America and one in eastern Asia shows the genus to be a relict one of so-called Arcto-Tertiary Flora. Doubtless cytological investigation on the 3 species interests us. The chromosome number is $n=11$ for *C. occidentalis* (Nicely 1965), $n=11$, $2n=22$ for *C. floridus* (Sax 1933, Nicely 1965, for *C. floridus* var. *oblongifolius* (Nutt.) B. E. Boufford et S. A. Spongberg (Sax 1933). We come to the conclusion, therefore, that the basic chromosome number of the genus is $x=11$.

2. *Chimonanthus praecox* (L.) Link

Somatic chromosome number $2n=22$ was determined based on mitotic metaphase of leaf-tip cells (pl. 1, fig. 3.). The material was pretreated with 0.05% Colchicine solution. The voucher specimen: Y. C. Tang & Q. Y. Xiang no. 84-83.

The species is widely cultivated and spontaneous only in western Hubei to eastern Sichuan. The present report is in accord with the number reported by Sugiura (1931) and Simonet and Miedzyrzecki (1932). All the records including ours are reported from cultivated plants.

Chimonanthus, with 3—4 species, is endemic to China (from the east to the west). The genus is divided into 2 groups. One, with *C. praecox* only, is deciduous and has sepals and petals rounded at apex. The other, including remaining species, is evergreen or semi-evergreen and has sepals and petals from acute to obtuse at apex. The chromosome number of the species, except *C. praecox*, is unknown to us. So it is a good material for further study to understand the speciation within the genus.

After the brief discussion on *Calycanthus* and *Chimonanthus*, it is probably not superfluous to remark cytotaxonomy of *Calycanthaceae*. Since the establishment of a new genus, *Idiospermum* based on *Calycanthus australiensis* by Baker in 1972, the circumscription of *Calycanthaceae* has been debated. Chant (1978), Takhtajan (1980), Thorne (1983) consider that *Calycanthaceae* consists of 3 genera (*Calycanthus*, *Chimonanthus* and *Idiospermum*). The subsequent intensive studies on *Idiospermum* have disclosed numerous differences between the genus and *Calycanthus*, supporting the establishment of a new family by Walker (1976), Wilson (1976, 1979), Sterner and Young (1980) and Cronquist (1981). No matter what rank is given to *Idiospermum*, it is indeed related to *Calycanthaceae*. If *Idiospermaceae* is merged into *Calycanthaceae*, it is merely demoted from family rank to a subfamily of *Calycanthaceae*. So we consider that the discrepancy of its circumscription is not important. The family was sometimes in the past referred to the *Rosales*. But modern authors, such as Chant (1979), Takhtajan (1980), Cronquist (1981), Thorne (1983), Dallgren (1983), agree that its close relatives are in *Laurales*. The facts that the family resembles *Monimiaceae* in a number of features and discontinuous distribution of its members show that the family is of great antiquity. Moreover, the basic chromosome number of the three genera is the same ($x=11$). It seems reasonable to suggest that the family consists of 3 genera and is subordinate to *Laurales*.

3. *Paris polyphylla* Sm. var. *chinensis* (Franch.) Hara

Somatic chromosome number $2n=10$ was determined based on mitotic metaphase of ovary-wall cells. No B chromosomes were observed (pl. 1, fig. 4). The material was pretreated with 0.05% colchicine solution. The voucher specimen: Y. C. Tang & Q. Y. Xiang no. 84-40.

Paris polyphylla Sm., distributed from the East Himalayas to Taiwan Province of China, is a very complex and polymorphic species. Hara (1969) divides it into 3 subspecies (subsp. *polyphylla*, subsp. *marmorata* and subsp. *fargesii*) and nine varieties. We agree with the treatment of Chang (1978), Takhtajan (1983) and Li (1984). They recognize subsp. *marmorata* and subsp. *fargesii* as species respectively. Even after these subspecies are separated as species, *Paris polyphylla* Sm. is still a rather complex one. The range of karyotype variation of the species is as great as that of gross morphology. The species has 8 cytotypes summarized by Hara (1969). Recently Gu (1982) observed 3 different populations of Yunnan province. He has discovered that the numbers of satellites and B chromosomes are variable. Even within a population (from Xundian) two homologous chromosomes of the pair B are different in length.

The karyotype of var. *chinensis* observed by us is somewhat different from those observed by Gotoh & Kikkawa (1937), whose materials are from Taiwan. Besides 2 B chromosomes found in Taiwan plants, the short arms of the homologous chromosomes of the pair C are different in length. Further detail studies to clarify the interrelationship and correlation of cytotypes with morphological characters in the complex are needed.

4. *Fritillaria thunbergii* Miq.

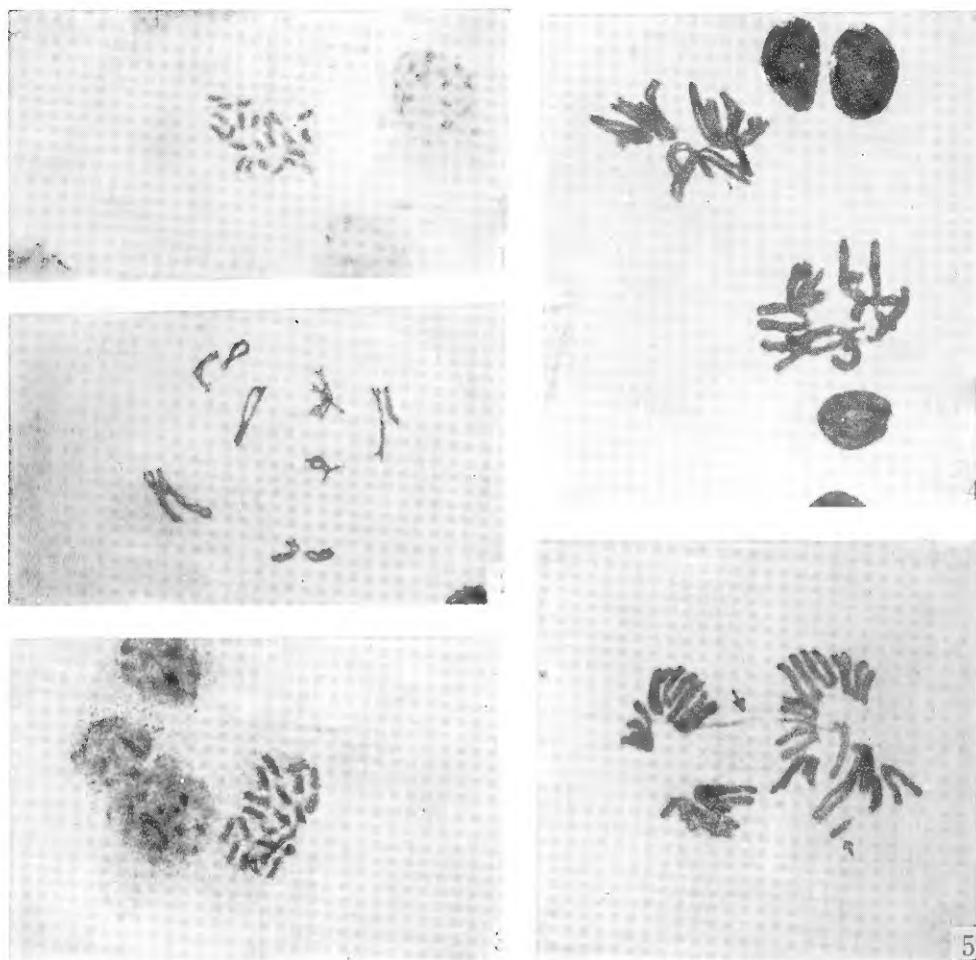
(*F. verticillata* Willd. var. *thunbergii* (Miq.) Baker)

PMC meiotic examination revealed $n=12$ at diplotene (pl. 1 fig. 2, 5). The material was pretreated with 0.05% Colchicine solution. The voucher specimen: Y. C. Tang & Q. Y. Xiang no. 84-22.

The species is distributed in Jiangsu, Zhejiang and Hunan of China and Japan, and also cultivated as a medicinal plant.

The present report is in accord with the one by Sato (1942) from Japanese material. A bridge and a fragment were found at AI. Generally considered, bridge and fragment at meiosis indicate the presence of heterozygosity for paracentric inversions. Certainly, heterozygosity for paracentric inversion can result in bridge and fragment, but bridges and fragments may also be resulted from chromosome breakage and reunion. The old literature is reviewed by Newman in the light of these findings and he concludes that the frequency of inversion in plant population has been overestimated (Grant 1975). So the explanation of the configuration observed in this species needs some more valid evidence.

Key words *Calycanthus chinensis*; *Chimonanthus praecox*; *Paris polyphylla* var. *chinensis*; *Fritillaria thunbergii*; Chromosome number; Cytogeography



1. *Calycanthus chinensis* 叶芽顶端细胞有丝分裂前中期 (leaf-tip cell, mitotic early metaphase), $2n = 22$, $\times 1056$. 2, 5. *Fritillaria thunbergii* 2. 花粉母细胞减数分裂前期 I: 双线期 (Diplotene PMC), $n = 12$, $\times 211.2$; 5. 花粉母细胞减数分裂后期 I, 箭头示染色体桥及断片 (AI in PMC, arrows showing bridge and fragment), $\times 422.4$. 3. *Chimonanthus praecox* 叶芽顶端细胞有丝分裂前中期 (leaf tip cell, mitotic early metaphase), $2n = 22$, $\times 1056$. 4. *Paris polyphylla* var. *chinensis* 子房壁有丝分裂中期 (ovary wall-cells, mitotic metaphase), $2n = 10$, $\times 422.4$.